

The Malayan Penaeidae (Crustacea, Decapoda)

Part I. Introductory notes on the species of the genera *Solenocera*, *Penaeus*, and *Metapenaeus*

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ALTHOUGH many workers have examined and described penaeid prawns taken from Malayan waters there has been published no discrete study of the Malayan Penaeidae. Mr. M. W. F. Tweedie, the Director of the Raffles Museum, Singapore, has built up a collection and I am sincerely grateful to him for permission to examine these specimens. I am grateful also to Professor R. D. Purchon for permission to examine the Penaeidae in the collection of the University of Malaya. The majority of the specimens examined in the preparation of this paper are in the collection of the Singapore Regional Fisheries Research Station (= S.R.F.R.S.), and it is a preliminary to one aspect of the programme of this Station, namely an economic biological study of the Malayan Penaeidae, that these taxonomic notes are produced. Part II of this series will be devoted to the species of the genera *Atypopeneus*, *Parapeneopsis*, *Trachypeneus*, *Metapenaeopsis*, and *Sicyonia*.

The Raffles Museum collection consists largely of specimens purchased from the Singapore Fish Market during the 1930's and there is no record of their date and origin, but it is probable that the prawns came from the local Singapore prawn ponds and local sung-dong nettings. The specimens in the collection of the S.R.F.R.S. were taken mainly by two techniques, (i) by the commercial prawn net of a prawn pond at Jurong, on the south-west coast of Singapore Island¹ and (ii), by Agassiz trawling from the S.R.F.R.S. launch "Chermin". Some few specimens were taken by hand during shore collections and others by commercial sung-dong net.

In this paper frequent reference is made to Kubo (1949). This author has made a comprehensive study of the Japanese Penaeidae which covers many of the Malayan species, but care has to be taken in the use of the paper as the text contains a number of apparent misprints.

In this present paper, the length of a prawn is indicated by the carapace length only, that is the distance from the supra-orbital margin to the mid-posterior margin of the carapace. (Cole and Mistakidis 1953).

In the records of prawns noted in the text, numbers prefixed by the letter "B" refer to S.R.F.R.S. Agassiz trawling stations, the location of which may be found by reference to the chart, Fig. 1, Plate 8.

The following is a list of the species of the genera considered in this paper recorded recently from Malaya, 18 in all. Four have been described as new and the types deposited in the British Museum:

Subfamily *Solenocerinae*

Genus *Solenocera* H. Lucas

Solenocera kubo sp. nov.

¹. I am sincerely grateful to the former owner and the present owner of the pond, Mr. William Chua, and Mr. Poh Kim Leng respectively for their kind co-operation.

Subfamily *Penaeinae*Genus *Penaeus* Fabricius (emend)

- Penaeus japonicus* Bate
P. latisulcatus Kishinouye
P. longistylus Kubo
P. monodon Fabricius
P. bubulus Kubo
P. penicillatus Alcock
P. merguensis De Man
P. indicus H. Milne-Edwards
P. jejunos sp. nov.

Genus *Metapenaeus* Wood Mason and Alcock (emend)

- Metapenaeus monoceros* (Fabricius)
M. intermedius Kishinouye
M. affinis (H. Milne-Edwards)
M. brevicornis (H. Milne-Edwards)
M. spinulatus Kubo
M. lysianassa (De Man)
M. necopinans sp. nov.
M. singaporensis sp. nov.

Family *Penaeidae* Bate 1888 (emend)Subfamily *Solenocerinae* Wood-Mason and Alcock 1891Genus *Solenocera* H. Lucas 1850 (emend)*Solenocera kubo* sp. nov. (Plate 9, Figs. 2, 3)

The body is glabrous. The carapace bears five spines: the antennal spine and the post-orbital spine are subequal in size; the supra-orbital spine, the hepatic spine, and the epigastric spine which is positioned posterior to the hepatic spine, are smaller than the other two and are subequal in size. The supra-orbital spine is rather blunt. The cervical groove is clearly defined over the ventral 3/4 of the distance between the hepatic spine and the mid-dorsal line. The anterior hepatic groove is well defined. As it leaves the hepatic fossa anteriorly it curves ventrally, and then recurves sharply antero-dorsally. The posterior hepatic groove is less clearly defined than the anterior portion. The branchiocardiac groove is well marked and takes the form of an open letter "S". Running for a short distance dorsally from the hepatic fossa is a broad, well defined groove, but it ceases before it reaches the base of the post-orbital spine. The cervical and the anterior hepatic carinae are sharply defined: the branchio-cardiac carina is bluntly defined, while the post-rostral carina, which extends to the posterior margin of the carapace, consists only of a low mid-dorsal elevation posterior to the confluence in the mid-line of the cervical grooves. The branchiostegite bears a sharp ridge which

commences anteriorly at the antero-ventral angle of the carapace and runs rearwards, somewhat inset from the ventral margin, until it curves dorsally meeting the ridge of the opposite side in the mid-dorsal line close to the posterior margin of the carapace.

The rostrum is straight and slightly inclined upwards. It is short in length, not attaining the distal margin of the basal segment of the antennular peduncle, although it does surpass the cornea. The dorsal margin of the rostrum is armed, in addition to the epigastric spine, with eight teeth, of which three are carried by the carapace.

The first and second segments of the abdomen are dorsally rounded. The abdomen is dorsally carinate from about mid-way along the third segment, the carina becoming gradually sharper rearwards until it terminates in the sixth segment in a spinule. The sixth segment, which has a ratio of length/depth of about 1.3, bears also a spinule on each postero-ventral margin, set somewhat anterior to the postero-ventral angle. The posterior margins of the third, fourth and fifth segments are incised in the mid-dorsal line, that of the fourth deeply so.

The telson, which bears dorsally a median sulcus, is $1\frac{1}{2}$ times as long as the sixth abdominal segment and just attains the tip of the outer uropods. It is quite unarmed.

The basal segment of the eye-stalk bears dorsally a horizontal, flattened scale which is directed anteriorly. The eye is small; measured in the longer diameter of the cornea it is about $\frac{1}{6}$ the length of the carapace. The prosartema attains the distal margin of the first segment of the antennular peduncle: the stylocerite, which has a blunt apex, attains the anterior half of the cornea. The basal segment of the antennular peduncle has a broad outer margin, and bears a spine at its outer distal angle. The second segment of the antennular peduncle is almost as long as the basal segment and is about twice as long as the distal segment. The upper and lower antennular flagella are almost equally foliaceous, and are about $1\frac{1}{2}$ times as long as the carapace. The lower flagellum is reduced to a point in the last eight articles; the upper flagellum is reduced to a blunt point in the last three articles. The basicerite has a well defined spine on the distal margin. The scaphocerite surpasses the antennular peduncle, the lamina of the scale slightly exceeding the lateral spine.

The third maxilliped slightly exceeds the tip of the scaphocerite: the first leg just surpasses the carapocerite and bears a basial and an ischial spine: the second leg, which bears a basial spine only, just attains the apex of the scaphocerite: the third leg surpasses the antennal scale by the chela and $\frac{1}{4}$ of the carpus, which joint is thick in the proximal $\frac{1}{3}$ but narrows to a slender distal $\frac{1}{2}$: the fourth leg reaches the apex of the scaphocerite, the dactylus of this leg being spatulate. The fifth leg exceeds the tip of the antennular peduncle by the distal two complete joints. This leg is slender, and the propodus bears at its distal end, in addition to the dactylus, a tuft of long setae.

The petasmat endopodites are extremely thin, membranaceous structures, and are best described by illustration.

This description is based upon the only specimen available, a male of 2.2 cm. carapace length, which is therefore the holotype. It was taken by Agassiz trawl at Station B 77, off Tanjong Stapa, in 6 to 7 fm., from a muddy substratum.

The present species is similar in many respects to *Solenocera subnuda* Kubo, particularly in the absence of telson spines and the pterygostomial spine, and in the presence of such features as the well marked branchio-cardiac groove, the fifth leg surpassing the antennular peduncle by the distal two joints, the post-rostral carina extending to the posterior end of the carapace, having eight rostral teeth and a straight rostrum slightly

inclined upwards and reaching a little behind the distal end of the basal segment of the antennular peduncle, and in having three of the rostral teeth borne by the carapace, but it may be distinguished from *S. subnuda* by such features as:

1. The anterior hepatic groove descends more steeply and is more acutely re-curved.
2. The anterior border of the carapace ventral to the antennal spine is not straight as illustrated by Kubo but is concave.
3. The post-rostral carina is not well defined.
4. The supra-orbital spine is clearly defined.
5. The second abdominal segment has no dorsal carina.
6. The eyes are rather small.

From *S. prominentis* Kubo, to which it is superficially similar, the present species may be distinguished by the absence of telson spines, by the small eyes, by the ill defined post-rostral carina and by the well marked branchio-cardiac groove. Finally, from *S. crassicornis* (H. Milne-Edwards) it may be distinguished by the presence of only eight rostral teeth and by the absence of a pterygostomian spine.

This present species I dedicate to Dr. Itsuo Kubo, of the Tokyo College of Fisheries.

Subfamily *Penaeinae* Burkenroad 1934a (emend)

Genus *Penaeus* Fabricius (emend)

***Penaeus japonicus* Bate (Plate 9, Fig. 4)**

This species is well illustrated by Alcock (1906) under the name of *Peneus canaliculatus*, and there is close agreement between the specimens found in Singapore and the descriptions given by De Man (1911) and by Kubo (1949). Kubo's description and the condition found in Singapore differ in two particulars, namely, in the relative lengths of the pereopods, and in the shape of the thelycum. The first legs reach only half way along the carpocerite, being considerably shorter than those seen by Kubo, but the illustrations by both Kishinouye (1900) and Alcock (op. cit.) agree with the Singapore specimens. The second and third legs are a little longer than those described by Kubo, while the fourth and fifth legs are slightly shorter. The second leg surpasses the basicerite by the entire chela (dactylus plus propodus) reaching the tip of the stylocerite: the third leg reaches mid-way along the second segment of the antennular peduncle; the fourth leg reaches the distal end of the carpocerite, while the fifth leg just surpasses the distal end of the carpocerite. Kubo notes that the first, fourth and fifth legs attain the same point anteriorly, but in the Singapore specimens this condition is shown by the second, fourth and fifth legs. Possibly there has been a misprint in Kubo's text as the illustrations by both Kishinouye (op. cit.) and Alcock (op. cit.) agree well with the specimens to hand.

The seminal receptacle of the Singapore specimens is by no means cylindrical, but is flattened considerably dorso-ventrally, nor has the anterior opening the simple form illustrated by Kubo (op. cit.) on page 115, fig. 49a. A closer resemblance is given on page 130 by that author, and by Alcock in fig. 6c, but none quite depict the condition found in the Singapore specimens (Fig. 4).

The specimens studied are in the collections of the Raffles Museum and the Department of Fisheries, Singapore. No specimens have been taken by the S.R.F.R.S.

***Penaeus latisulcatus* Kishinouye**

The Singapore specimens agree well with the description given by Kubo (1949), there being three minor differences only. The prosartema is somewhat shorter than in the Japanese specimens: it does not surpass the cornea, and falls appreciably short of the distal end of the first segment of the antennular peduncle. The fourth and fifth legs are a little longer than those of Kubo's specimens, each surpassing the basiscerite by almost the whole of the finger. Although the ischium of the first pereiopod bears no spine, the ridge along the inner face of that joint terminates distally in an acute angle.

It may be noted that, in one female examined, having a carapace length of 3.4 cm. the lateral plates of the thelycum meet in the centre line, forming small flaccid lips along the juxtaposed length.

The following records are available for specimens taken by the S.R.F.R.S.

B. 20. Johore Shoal, 4-9 fm. Sand.

B. 49. Siglap Coast, 1-4 fm. Muddy sand.

— Changi Beach, Muddy sand.

***Penaeus longistylus* Kubo (Plate 9, Fig. 5)**

The single specimen of this species examined, a female of 4.3 cm. carapace length, was obtained from the Singapore Fisheries Department, having been caught during trawling experiments off the east coast of Malaya in 1926, and is now in the collection of the Raffles Museum.

There is very close agreement with the description given by Kubo (1949), but the following differences are noted:

1. The stylocerite attains only 0.8 of the length of the first segment of the antennular peduncle, being slightly shorter than the condition found by Kubo, where the stylocerite attained the distal end of that segment.

2. The first leg falls slightly short of the distal margin of the carapocerite.

3. The second leg exceeds the tip of the first leg by the finger plus only a quarter of the palm.

4. The seminal receptacle is slightly longer than wide, 1: 0.8 (as long as wide in Kubo's specimens) and at the mid-line the lateral plates form thin but extremely elevated lips (Fig. 5) of which no mention was made by Kubo, while the outline of the lateral plates is more angular than illustrated by Kubo.

5. The red pattern on the side of the third pleonic somite is absent in the Raffles Museum specimen, but this is almost certainly the result of 29 years preservation in alcohol.

***Penaeus monodon* Fabricius**

The specimens studied agree with the description by Kubo (1949) in all respects save one, namely that the third pereiopod attains the tip of the scaphocerite, a condition slightly longer than that found in the Japanese specimens. In a description of this species by Bate (1888), the third pereiopod is shown to extend beyond the scaphocerite by three quarters of the chela, which places the Singapore specimens in an intermediate position in respect of the appendage.

Although Kubo makes no note, Kishinouye (1900), in his illustration of this species under the name of *P. ashiaka*, shows three ridges borne laterally on the t₆ of the sixth abdominal somite: in the specimens to hand, there is also a single ridge borne laterally by the fifth abdominal somite.

Penaeus carinatus Dana (1852) and *Penaeus semisulcatus* De Haan (1850), are probably identical with this species (De Man 1888). In respect of *P. carinatus* there is no point of disagreement, and the only differences between *P. monodon* and *P. semisulcatus*, taken from De Haan's illustration (by Kubo op. cit.), are 1. The third leg surpassing the scaphocerite by half of the chela in *P. semisulcatus* and 2. The antennular flagella are at least as long as the peduncle in *P. semisulcatus* while they are only half as long as the peduncle in *P. monodon*. It seems likely that the former difference is not valid as there is certainly some variation in the length of this appendage, while the latter may well be the result of inaccurate drawing or an unusual model.

In Singapore, immature specimens are not uncommon in prawn ponds, where they live on a muddy bottom, but never do they form more than a very small percentage of the catch (approx 1 per cent). The records for the other specimens in the collection of the S.R.F.R.S. are:

- B. 54. Damar Laut, 5-8 fm. Mud.
- B. 63. Siglap (Sung-dong net) Muddy sand.
- B. 79. Off Tanjong Stapa, 23 fm. Mud (adult female).

Penaeus bubulus Kubo

The Singapore specimens agree well with the description of this species given by Kubo (1949). It may be noted that this species differs from *P. monodon*, *P. carinatus*, and *P. semisulcatus* in having no exopodite on the fifth leg.

P. bubulus is by far the largest prawn caught in Singapore, specimens of 5 cm. carapace length being taken with some regularity. Juvenile and adult specimens are features of prawn pond catches where their size, but not their numbers, make them important.

The S.R.F.R.S. has only one other record:

- B. 71. Geylang River, 1 fm. Mud.

Penaeus penicillatus Alcock (Plate 9, Fig. 6)

Penaeus penicillatus Alcock, *P. merguensis* De Man, and *P. indicus* H. Milne-Edwards are three very similar species. Although adults demonstrating the features typical of the respective species may be identified fairly easily, there are many cases in which features of all three species may be exhibited by a single individual.

Considering the illustrations given by Alcock (1906), several features suggest themselves as of possible diagnostic importance, differences in the rostrum shape and length, the condition of the third maxilliped in the adult male, differences in the relative lengths of the antennular flagella, in the carinae of the carapace, in the stylocerite, and in the spine on the antennal scale. Certainly the length of the dactylus of the third maxilliped of adult males, 1.5-2.7 times the propodus, is diagnostic, but the specimens of *P. penicillatus* studied showed only a single feature applicable to both sexes, constant, yet differing from the condition found in *P. merguensis* and *P. indicus*, namely the length and form of the gastro-orbital carina. (Figs. 6, 7 & 8). In the Singapore specimens the gastro-orbital carina agrees well with the illustration by Alcock (op. cit.); it is relatively short in length occupying about the central half of the distance between the hepatic spine and the post-orbital margin, and it is only poorly defined. In this respect the description given by Kubo (op. cit.) is at variance. Kubo describes the gastro-orbital carina of this species as "... rather defined, ... occupies posterior two-thirds of the distance between the post-orbital margin and the hepatic spine." which condition is exhibited by none of the Singapore specimens so far examined.

The rostrum form is in general agreement with the illustration by Alcock (op. cit.), but in length it surpasses the tip of the antennal scale, a feature noted also by Kubo (op. cit.).

Other differences between the description given by Kubo (op. cit.) and the specimens to hand are:

1. The third maxilliped is somewhat longer, reaching $2/3$ of the way along the third segment of the antennular peduncle, but it does not surpass the antennal scale, a condition shorter than that shown by Alcock (op. cit.).
2. The first and fourth legs are both a little shorter, reaching only $1/3$ of the way along the antennal scale, which follows closely Alcock's illustration.
3. The second leg attains the distal end of the first segment of the antennular peduncle, being slightly shorter than described by Kubo, but agreeing very well with Alcock.
4. The third leg is also shorter than noted by Kubo, falling short of the antennal scale by a distance equal to about half of the finger. In this case the specimen illustrated by Alcock occupies an intermediate position between the specimens described by Kubo and those from Singapore.

In the collection of the Raffles Museum are eight males and ten females; of the males only a single specimen is mature and exhibits the marked difference between the third maxilliped of such specimens and mature males of *P. merguiensis* and *P. indicus*.

Penaeus penicillatus is taken in prawn pond catches but the relative abundance of this species has yet to be determined.

Penaeus merguiensis De Man (Plate 10, Fig. 7)

De Man himself had doubts as to the validity of this species, first separating it from *P. indicus* Milne-Edwards (De Man 1888), later reuniting it (1892), and later still (1911) remarking "*Penaeus merguiensis* . . . ought, no doubt, to be considered as a distinct species".

Kubo (1949) considers there to be three features which may be used in the separation of *P. merguiensis* and *P. indicus*, namely:

1. The form of the gastro-orbital carina, which in *P. merguiensis* is bluntly defined while in *P. indicus* it is rather sharply defined.
2. The dactylus of the third maxilliped of adult males, half as long as the propodus in *P. merguiensis* but as long as the propodus in *P. indicus*.
3. The length of the third pereopod, which in *P. merguiensis* extends beyond the tip of the scaphocerite by about the entire chela while in *P. indicus* it surpasses the scaphocerite by about half of the chela only.

The extremely elevated post-rostral crest, so characteristic of adult *P. merguiensis*, which caused De Man (1911) to write when he was comparing the present species with *P. indicus* ". . . their outer appearance is so greatly different, especially as regards the shape of the rostrum that everyone will consider them as different species." receives no comment from Kubo.

The condition of the gastro-orbital carina of the adult specimens of *P. merguiensis* examined follows the description given by Kubo (op. cit.), and agrees with the illustration by Alcock (1906). This carina extends posteriorly further and is rather more clearly defined than in *P. penicillatus*, but it is definitely less sharp than in *P. indicus*.

However, the third of Kubo's differences is not valid for Singapore. In *P. indicus* the length of the third leg is quite variable, ranging from a condition in which the leg does not attain the tip of the scaphocerite, to one in which it surpasses the scaphocerite by the entire chela, while *P. merguensis* may have the third leg surpassing the scaphocerite by only the finger. The largest female of *P. merguensis* examined, having a carapace length of 3.4 cm., shows all of the pereopods to be somewhat shorter than the description by Kubo.

Juveniles of *P. merguensis* and *P. indicus* are rather more difficult to separate than are the adults. De Man (1911) has suggested that the presence of a single tooth on the upper edge of the rostrum anterior to the tip of the antennular peduncle is probably indicative of *P. merguensis* while its absence is probably indicative of *P. indicus*. (Compare Alcock (1906) Fig. 3a and De Man (1911) Fig. 33a). In Singapore, juveniles may be found readily which cover the entire range of rostral form between that illustrated by Alcock (op. cit.) as typically *P. indicus* to that illustrated by De Man (1911) as typically *P. merguensis*. In view of the relative scarcity of adults of *P. merguensis* in Singapore, and the abundance of prawns exhibiting the features of *P. indicus*, it seems likely that the majority of these juveniles are of *P. indicus*, but at present there seems to be no means of determining the degree of coincidence which these juveniles exhibit.

***Penaeus indicus* H. Milne-Edwards (Plate 10, Fig. 8)**

In respect of this species much has been noted in dealing with *P. penicillatus* and *P. merguensis*; comment was made on the discrepancy between the length of the third pereopod found in Singapore and the description given by Kubo (1949), apart from which there is fairly close agreement. It may be added that the Singapore specimens exhibit the form of the third maxilliped of adult males illustrated by Alcock (1906) in which the ratio dactylus/propodus is 0.85 and not "about 1" as noted by Kubo (op. cit.) and De Man (1911), but agreeing with Kubo is the rudimentary nature of the tuft of setae at the tip of the propodus of this appendage.

P. indicus is probably the most numerous of the Singapore Penaeidae. It is always present in the catch of the prawn ponds where it may form more than 80 per cent by numbers of the total. It may be taken also by sung-dong net off Siglap and probably from other parts of the coast-line. All the records of this species to date in Singapore are from a mud or a muddy sand substratum.

***Penaeus jejunos* sp. nov. (Plate 10, Figs. 9, 10)**

This species is described from the holotype, a single female having a carapace length of 1.5 cm., found while examining the collection of the Raffles Museum. There is no record of its origin, but it is probably from the neighbourhood of Singapore.

The carapace and abdomen are glabrous. The carapace bears a long, rather slender antennal spine, a stout hepatic spine which is set below the rostral tooth immediately anterior to the epigastric spine, and a well defined supra-orbital spine. The orbito-antennal groove is deep. The hepatic groove and the cervical groove are well defined in the region of the hepatic spine, but their termination is abrupt. The cervical groove is directed towards the mid-line of the posterior margin of the carapace but it extends only 1/4 of the way to that margin. The portions of the hepatic groove anterior and posterior to the hepatic spine are of about the same length as the cervical groove. The gastro-frontal groove and the adrostral groove are both deep. The adrostral groove is broader over that portion of its length running from the posterior end of the gastro-frontal groove to the epigastric spine than over the remainder of its length. Anteriorly the

adrostral groove extends to in front of the distal rostral tooth, becoming narrower as it proceeds forwards: posteriorly the groove, which is about as wide as the post-rostral carina, stops abruptly a little short of the posterior margin of the carapace. The antennal, hepatic, cervical, gastro-frontal and adrostral carinae are all sharply defined. The post-rostral carina is bluntly defined and bears a shallow median groove, in length about $1/3$ of the distance between the epigastric spine and the posterior margin of the carapace, set a little behind the epigastric spine.

The rostrum is similar to that of *P. japonicus* Bate, proximally decurved, distally slightly recurved, the transition occurring at the level of the single tooth on the ventral margin. On the upper margin of the rostrum, in addition to the epigastric spine are borne eleven teeth of which four are placed on the carapace. The rostrum just surpasses the distal tip of the antennular peduncle, and is unarmed in the distal $1/5$.

The first four abdominal segments are dorsally rounded. The fifth segment is dorsally bluntly carinate, while the sixth segment bears a sharp carina which terminates posteriorly in a stout spine. The sixth segment bears also a well defined spinule at each postero-ventral angle. The posterior margins of the fourth and fifth segments are incised in the mid-line. Cicatrices, three in number of which the foremost is ill defined, are present on the left hand side of the sixth abdominal segment only. The sixth segment is half as long as the carapace and has a length/depth ratio of 1.4.

The telson, which has a deep median sulcus, is as long as the sixth abdominal segment and is well surpassed by both the inner and outer uropods. It bears on the right hand side two, and on the left hand side three dorso-lateral moveable spines: it appears that the spines of the right hand side are paired by the two anterior spines of the left hand side, but there is no indication of an articulation on the right hand side posterior to the two spines.

The eyes are ill preserved, but it seems that the prosartema extends to their distal margin, while the stylocerite attains about the middle of the cornea. The basal segment of the antennular peduncle bears a well defined spine at its distal outer angle. The distal segment of the antennular peduncle is small, being only $1/3$ the length of the second segment. The antennular flagella are somewhat damaged but appear to be about $1/4$ to $1/3$ the length of their peduncle. The basicerite bears a well defined spine on the distal ventro-lateral margin. The lateral spine of the scaphocerite surpasses the tip of the antennular peduncle, and is in turn surpassed by the lamina of the scale.

The third maxilliped surpasses the carpocerite by the dactylus and propodus: the first leg attains the proximal margin of the carpocerite, and bears a stout basal and a stout ischial spine: the second leg surpasses the carpocerite by a finger, and bears a basal spine only: the fourth leg, which bears a small coxal plate, attains the distal end of the carpocerite: the fifth leg just surpasses the distal end of the carpocerite. All of the pereopods bear an exopodite.

The thelycum consists of two posterior lateral plates, not fully developed in this specimen, and an anterior sternal projection which bears at its forward end a single median spinule directed anteriorly.

Superficially this species resembles closely both *P. japonicus* Bate and *P. latisulcatus* Kishinouye but it differs from them in a number of details. The thelycum has two discrete posterior lateral plates and obviously has not the structure of *P. japonicus*, while the anterior lobe of the thelycum lacks the bifurcation found in *P. latisulcatus*. This present species may be separated also from both *P. japonicus* and *P. latisulcatus* by the presence of an ischial spine on the first leg, by the form of the median groove of

the post-rostral carina which is not well defined as in the two above named species, and by the form of the adrostral groove which is markedly decreased in width at the level of the epigastric spine.

In respect of the median groove on the post-rostral carina and the armature of the pereopods this present species resembles *P. longistylus* Kubo but it may be distinguished from it by the stylocerite not attaining the distal end of the basal segment of the antennular peduncle and by the adrostral groove being only about as wide as the post-rostral carina, and not about 1.5 times the width. From *P. plebejus* Hess the present species may be distinguished by the gastro-frontal groove being bifurcate posteriorly and by the median groove on the postrostral carina not extending backwards to the posterior end of the adrostral groove. From *P. teraoi* Kubo it may be distinguished by the presence of the ill defined median groove on the postrostral carina, and by the thelycum not possessing an anterior lanceolate process on the median lobe. The absence of a dorsal carina from the fourth abdominal segment distinguishes the present species from all the above cited species.

Genus *Metapenaeus* Wood Mason and Alcock 1891

Metapenaeus monoceros (Fabricius)

The situation in respect of this species is somewhat complex, for, in addition to the setose *forma typica*, there is in Singapore a form which is almost completely glabrous anteriorly, while between these two extremes there are a number, possibly infinite, of intermediates. The setose condition, in general shows excellent agreement with the descriptions given by Kubo (1949) and others. There are some differences, most notably in the male genitalia. The disto-median lobes of the petasma are shown by Kishinouye (1900 under the name of *Penaeus incisipes*) and Kubo (op. cit.) to be directed distally, by De Man (1911) to be directed disto-medially, while by Alcock (1906) to be directed disto-laterally. The Singapore specimens all show the latter condition, but the shape of the disto-median lobes is at variance with Alcock's illustration (Fig. 11) as is also the size of the spine borne by the merus of the fifth leg of adult males. In no case has a spine as big as that shown by Alcock been found. The illustrations of the thelycum by the above named authors agree well with the condition found in the Singapore specimens.

Kubo (op. cit.) notes that the dorsal carina, present on all six abdominal somites, gets gradually sharper posteriorly. The specimens studied all show a marked increase in the sharpness of the carina in the fourth abdominal somite, with a further gradual increase in the sharpness from there backwards. A further point of disagreement concerns the telson which to date has been described as unarmed. The Singapore specimens all show a row of about 40 minute moveable spinules resembling sturdy setae along each dorso-lateral margin, with, inset from these, a second, rather diffuse row. (Fig. 12b).

The glabrous form of *Metapenaeus monoceros*, which was initially considered by me to be a distinct species, differs from the *forma typica* in several respects unrelated to size. The carapace is devoid of setae save for the area at the base of the rostrum, and in consequence, the branchio-cardiac carina is not well pronounced as it does not stand out as a glabrous ridge against a pilose background. The abdomen is devoid of setae anteriorly, but becomes gradually more setose posteriorly. The dorsal carination of the abdominal somites is restricted to segments four, five and six, while the irregular ridges are less pronounced on the glabrous terga save for the most posterior segment, which is markedly setose. The telson bears the dorsolateral spinules noted in the *forma typica*.

A great difference is found in the lengths of the thoracic appendages of the setose and the glabrous forms:

Setose condition	Glabrous condition
3rd. mxpd. Attains tip of carpocerite	Exceeds carpocerite by up to dactylus.
1st leg. Attains tip of carpocerite	Exceeds carpocerite by finger.
2nd leg. Exceeds carpocerite by about finger	Attains tip of scaphocerite.
3rd leg. Barely reaching tip of antennular peduncle	Exceeds scaphocerite by whole of chela.
4th leg. Exceeds basicerite by dactylus	Exceeds scaphocerite by dactylus.
5th leg. Almost reaches the distal end of the second segment of the antennular peduncle	Attains tip of scaphocerite.

These appendages are all longer in the extreme glabrous condition than in the setose, and considered in conjunction with the differences previously described suggest a distinct species. However, I can find no difference between the petasma of the setose and the glabrous males, nor between the thelycum of the setose and glabrous females: moreover, between the setose and the glabrous forms may be found specimens showing intermediate features, for example, specimens showing an abdominal carina on segments one, four, five and six, and others on segments one, two, four, five and six, with corresponding degrees of setae abundance, while setose and glabrous forms may have identical leg lengths intermediate between the two extremes.

The biological study of *Metapenaeus monjoceros* has not proceeded sufficiently far to be able to say whether or not there is any periodicity in the relative abundance of these two forms, although it is clear that the relative abundance is not constant in prawn pond catches, nor am I yet able to say whether the differences in form are due solely to environmental causes.

Both forms are taken regularly from the Jurong prawn pond with, in general, the glabrous form predominating.

Metapenaeus intermedius Kishinouye

The Singapore specimens of this species follow closely the descriptions and illustrations given by Kubo (1949), save that the third and fourth pereopods are each half a dactylus longer, and the rostrum may be slightly upturned in front of the most anterior rostral tooth, mainly in the lower border.

Burkenroad (1934b) described three specimens of this species referred by him to *Metapenaeus intermedius* var. *anchista* (De Man), one of which was from Singapore, which seemed to cause Kubo (op. cit.) some misgivings. The features in question are 1. Kubo's specimens show a straight rostrum, while Burkenroad's have a rostrum either straight or a little upturned at the tip. This seems to be a very minor point, and my specimens agree with Burkenroad's. 2. Kubo's specimens show two rostral teeth lying on the carapace while Burkenroad's had but one. In general the Singapore specimens agree with Kubo, but in at least two adult specimens seen by me, one male and one female,

three teeth were included on the carapace. There would appear to be some variation in this feature. 3. The form of the petasma of the Singapore specimens follows the description and illustrations of Kubo. The disto-lateral projections do not "overlap on the disto-median projections". (Fig. 13). 4. Kubo speaks of the median plate of the thelycum extending "as a high ridge to ca. the middle of the penultimate thoracic sternite" yet he shows nothing of this in his illustration of that organ which agrees in all respects with the specimens studied by me. Burkenroad's (Hong Kong) female had the median plate of the thelycum emarginate on the anterior border. The median plate in the Singapore specimens is certainly elevated from the sternum, but not as a ridge. It is overlain by setae and by the coxal projections of the fourth leg and is seen in ventral view only with difficulty. In two adult Singapore females taken from the same locality, one had the anterior edge emarginate, the other had not. I consider it unlikely that the two writers should be describing different species.

It may be noted that the Singapore species is not *Penaeus ensis* De Haan (1850) from which it may be recognised by the features noted by De Man (1920 and 1922).

Juveniles of *Metapenaeus intermedius* Kishinouye are taken fairly regularly from the Jurong prawn pond, but never in great numbers. Adults have been taken from the sea by the S.R.F.R.S. in 20-40 fathoms. The records for this species are:

- B. 31. Ajax/Sultan Shoal, 9 fm. Stone.
- B. 45. Outer Shoal. 6 fm. Mud/Stone.
- B. 48. 1 mile west of Bedok. 1 fm. Sand.
- B. 49. Siglap coast. 1-4 fm. Muddy sand.
- B. 50. Tanjong Rhu. 2 fm. Mud.
- B. 59. South of Singapore. 25-30 fm. Clean bottom.
- B. 60. South of Bedok. 22 fm. Clean bottom.
- B. 65. South of Bedok. 24 fm. Clean bottom.
- B. 73. South of Singapore. 38-42 fm. Rock.
- B. 75. South of Singapore. 35 fm. Clean bottom.

Within the waters around Singapore, *Metapenaeus intermedius* Kishinouye seems fairly ubiquitous, but there is some indication that adults are more likely to be taken on clean sea beds in deeper water while juveniles are more likely to be taken in shallower water from a muddy bottom.

Metapenaeus affinis (H. Milne Edwards) (Plate 11, Fig. 14)

Firstly it must be noted that both Kubo (1949) and De Man (1911) considered the prawn described by Alcock (1906) under the name of *Metapenaeus affinis* (H. Milne Edwards) to be that species. The penaeid so named by Alcock (op. cit.) bears but little similarity to *M. affinis* (H. Milne Edwards) and will be found in this paper redescribed as the new species *Metapenaeus necopinans*.

The description of *Metapenaeus affinis* (H. Milne Edwards) given by Kubo (op. cit.) is at variance with the condition found in the Singapore specimens in a number of respects. The characteristic petasma of the adult male is well illustrated by De Man (op. cit.) Kubo (op. cit.) and Kishinouye (1900), but not so the equally characteristic thelycum of the adult female (Fig. 14). The illustration of this organ by Kishinouye

(op. cit.) more nearly represents the condition found in the specimens studied by the present author, but Kubo (op. cit.) omits completely the median plate, possibly intending to show that this plate is somewhat depressed in ventral view.

The carapace of *M. affinis* resembles closely that found in the glabrous form of *M. monoceros* (Fabr.), but may be distinguished from it by the shape of the hepatic groove. In *M. monoceros* the general appearance of this groove is somewhat "C" shaped, while in *M. affinis* there is a sharp change in direction between the portion of the cervical groove running straight vertically from immediately in front of the hepatic spine, and the anterior portion of the hepatic groove which runs straight antero-ventrally. This is at variance with the written description given by Kubo (op. cit.) although both his and Kishinouye's (op. cit.) illustrations demonstrate this feature.

The specimens studied by Kubo bear no spine on the basicerite, but in more than half the Singapore specimens examined, a spine, sometimes rather blunt, is borne on the outer distal margin.

The telson of *M. affinis* has been described previously as unarmed, but, as in *M. monoceros*, a distinct (single) row of minute moveable spinules, about 20 in number, is found by the present author along each dorso-lateral edge, those more posterior being rather more defined than those more anterior.

Kubo's paper (op. cit.) exhibits some confusion in respect of the armature of the ischium of the first pereopod. In the table on p. 47 (type K6) *M. affinis* is listed as bearing an ischial spine on the first leg, but the key to the species of *Metapenaeus* on p. 328 uses the absence of a spine from this joint to separate *M. affinis* (and other species) from *M. monoceros* (Fabr.) and *M. intermedius* Kishinouye. In most of the Singapore specimens a small but usually distinct spine is found, while in one specimen examined the ischial spine of the first leg on the left hand side was $\frac{1}{3}$ the length of the basal spine of that leg, a smaller spine of more normal proportions being found on the right hand side.

The second, third, fourth and fifth pereopods of the Singapore specimens are somewhat longer than described by Kubo (op. cit.). The second leg exceeds the basicerite by the entire chela: the third leg exceeds the carpocerite by the entire chela: the fourth leg surpasses the basicerite by the dactylus: the fifth leg surpasses the carpocerite by the dactylus.

It may be noted that, laterally, the fifth and sixth abdominal segments bear a median wavy line similar to that found in *M. monoceros* (Fabr.) while the sixth segment shows also indications of a more dorsal and a more ventral line but not as clearly defined as in *M. monoceros*.

M. affinis (H. Milne Edwards) is taken regularly in the Jurong prawn pond catches where it may form over 50 per cent of the total numbers. It is taken too in sung-dong net catches. Records of catches by Agassiz trawl are:

- B. 41. Angler Buoy, 4-7 fm. Mud.
- B. 43. Angler Buoy, 5 fm. Mud.
- B. 45. Outer Shoal, 6 fm. Mud/Stone.
- B. 49. Siglap Coast, 1-4 fm. Mud/Stone.

A single specimen of this species has been taken by hand net as it swam at the surface attracted to a kerosine lamp suspended over the side of a boat. The depth of water at the time was 45 fm., the position being about that of Station B. 73. Apart from this, no specimen has been taken in Singapore from other than a muddy substratum.

Metapenaeus brevicornis (H. Milne Edwards)

The Singapore representatives of this species show the third maxilliped and all of the pereopods, excepting the first slightly longer than described by Kubo (1949), in all cases by a length about equal to the dactylus of the appendage. A very close agreement with all other features is found, save in the description of the telson which Kubo states is unarmed.

The telson condition typical of the juveniles found in Singapore shows a single pair of larger moveable dorso-lateral spinules set at approximately $1/6$ the length of the telson from the posterior tip, preceded by about 20 to 25 pairs of much smaller moveable spinules the size of these decreasing somewhat anteriorly. Occasionally a minute pair is found posterior to the larger pair. The typical condition is found rarely in mature specimens: it appears that the smaller spinules are lost, possibly by abrasion, irregularly along the row, although more extensively so anteriorly. Even the large pair of spinules may be absent in adults although in such cases the place of their recent articulation with the telson is usually apparent. One large specimen examined, with a carapace length of 3.3 cm., showed the large pair of spinules still intact and nine approximately paired smaller spinules anterior to it. This specimen exceeds in length any of those examined by Kubo (op. cit.).

It may be noted that previously only De Man (1924) and Burkenroad (1934b) have identified specimens showing lateral spinules on the telson with this species, but Kubo (op. cit.) considers that Burkenroad's specimens are probably referable to *Metapenaeus spinulatus* Kubo. In the case of the Singapore specimens (Fig. 12a) this is certainly not so: thelycal and petasmas features are in precise agreement with *Metapenaeus brevicornis* (H. Milne Edwards), and differ in the thelycum (no male of *M. spinulatus* Kubo has been described) from *Metapenaeus spinulatus* Kubo, females of which have been examined by the present author.

The specimen of *M. brevicornis* (H. Milne Edwards) illustrated by Alcock (1906) is shown without a high post-rostral crest which is markedly different from the specimens examined by Kubo (op. cit.) and noted by that author, and from the majority of the Singapore specimens examined by the present author. However, five adult males in the collection of the Raffles Museum taken from the Singapore fish market in 1934, show the post-rostral condition illustrated by Alcock (op. cit.) although in other respects they do not differ from the normal. All of these five males possess minute telson spinules, and four of the five retain intact the pair of larger telson spinules.

Metapenaeus spinulatus Kubo

Four females of this species have been examined in Singapore: three of them are in the collection of the Raffles Museum, the fourth is in the collection of the S.R.F.R.S. No male has yet been identified.

All the intact legs of the Singapore specimens, excepting the fourth which follows the original description (Kubo 1949), are slightly shorter than in Kubo's specimens. (The holotype and two paratypes were obtained by Kubo from Bangkok). The first leg does not quite reach the distal end of the carapocerite, falling short of this length in one specimen by a distance equal to the finger: the second leg slightly surpasses the proximal margin of the intermediate segment of the antennular peduncle but does not attain the distal margin of the segment: the third leg slightly surpasses the scaphocerite: the fifth leg surpasses the scaphocerite by the dactylus and only $1/3$ of the propodus. It should

be noted that the description of the spines borne by the pereopods given by Kubo (op. cit. p. 357) is misprinted. There it is stated that the second and third legs bear ischial spines: the operative adjective should of course be "basial."

Other minor differences between the Singapore specimens and those described by Kubo are noted; the rostrum is in each case slightly uptilted in the distal portion which is devoid of teeth: the rostral crest is slightly more elevated than illustrated by Kubo: the sides of the rostral crest are setose, and the second segment of the antennular peduncle is 2 to 2½ times the length of the third (Kubo (op. cit.) says 3 times on page 356, as long as on page 358, while his illustration of the species gives 2½ times). A further discrepancy lies in the armature of the telson, described by Kubo (op. cit.) as consisting of two pairs of lateral spinules near the apex. Three of the Singapore specimens show the two pairs of spinules noted by Kubo, set at about 1/6 and 1/4 the length of the telson from the posterior tip: the fourth specimen bears only the more posterior of these two pairs, but all of the specimens show in addition a row of minute moveable spinules set along each dorso-lateral edge, resembling closely the condition described by the present author for *Metapenaeus brevicornis* (H. Milne Edwards), two or three of these spinules being placed between the larger spinules on each side, while about a dozen precede each of the anterior larger spinules. In all cases it is obvious that some of these minute moveable spinules have been lost as their previous points of articulation are evident along the rows.

In all other respects the Singapore specimens agree well with the description and illustration given by Kubo (op. cit.).

The single female in the collection of the S.R.F.R.S. was taken in a random sample of a prawn pond catch from Jurong on 18th May, 1954.

Metapenaeus lysianassa (De Man)

The Singapore specimens show excellent agreement in all important features with the original description given by De Man (1888), and with those given also by Alcock (1906) and by Kubo (1949). In respect of the spinules borne by the telson it must be noted that De Man (op. cit.) was perfectly well aware of their existence. In his original description (1888) he illustrated them, although in that text he referred to them as "hairs". In a later paper (1920) he stated "The examination revealed the remarkable fact, . . . that, . . . the lateral margins of the telson are armed with numerous little spines up to a short distance from the acuminate tip . . .", and I can only conclude that Kubo (op. cit.) misinterpreted these texts and the illustration.

Although Kubo (op. cit.) remarks on the absence of a spine on the disto-lateral margin of the basicerite, a small spine is found in the Singapore specimens on the distal margin, set however rather more ventrally than laterally.

The third maxilliped and all of the walking legs are somewhat shorter in the Singapore specimens than in those studied by Kubo (op. cit.). The third maxilliped barely surpasses the distal end of the carpocerite and is intermediate between De Man's and Kubo's specimens: the first and fourth legs just surpass the proximal end of the carpocerite: the second leg surpasses the carpocerite by a finger: the third leg does not surpass the tip of the scaphocerite, attaining only the distal end of the antennular peduncle and is intermediate between De Man's and Kubo's specimens: the fifth leg reaches forwards to the same level attained by the second leg and does not surpass the antennal scale, a condition agreeing precisely with that found by De Man (1888) and by Alcock (op. cit.).

M. lysianassa (De Man) is taken irregularly, and even then in but small numbers, from the Jurong prawn pond. It has been found in sung-dong catches taken at Siglap (B. 69) and has been taken by Agassiz trawl as noted below:

B. 42. South of Singapore, 14 fm. Stone.

B. 45. Outer Shoal, 6 fm. Mud/Stone.

Three specimens of this species have been taken by hand net at night swimming at the surface attracted to a kerosine lamp suspended over the side of a boat. The depth of water at the time was 45 fm. the position being approximately that of Station B. 73.

Metapenaeus necopinans sp. nov. (Plate 11, Fig. 15; Plate 12, Fig. 16)

This species was described first by Alcock 1906, page 20, plate iii, fig. 8, who misidentified it as *Metapenaeus affinis* (H. Milne Edwards).

The body is generally finely setose. The antennal and hepatic spines are subequal in size. The epigastric spine is placed above the hepatic spine. The supra-orbital spine is clearly defined although it is smaller than the epigastric spine. The anterior hepatic groove is clearly defined, curving slightly as it runs antero-ventrally. The cervical groove is defined and reaches about half way to the mid-dorsal line although it is somewhat interrupted between its anterior end and the hepatic fossa, from whence it continues postero-ventrally until it joins the anterior hepatic groove in a sharp angle. The branchio-cardiac and antennal grooves are clear though less well defined than the cervical groove. The posterior hepatic groove is ill defined. The hepatic carina sharply delimits the anterior hepatic groove ventrally. The antennal carina is well defined: the branchio-cardiac carina is bluntly defined. A short, though well defined post-ocular groove is present below the base of the rostral tooth set immediately anterior to the epigastric spine.

The rostrum is somewhat sigmoid, usually reaching to or beyond the tip of the antennular peduncle. It bears 7 to 8 teeth spaced evenly along the dorsal border, 1 or 2 of the rostral teeth being placed on the carapace. Proceeding rearwards, a uniform increase in the size takes place over the anterior four to five teeth. (Alcock's fig. 8c. represents the usual condition found in Singapore). The post-rostral carina is rounded, becoming rapidly faint, and ceasing completely anterior to the rear border of the carapace. Large specimens carry a short glabrous shallow depression set about half way along the post-rostral carina.

The abdominal terga are marked by irregularly shaped glabrous ridges and areas, the latter more defined at the places where friction with the tergum of the preceding segment takes place. The first segment is dorsally rounded: the second segment bears a short, low, glabrous, mid-dorsal elevation set towards the anterior margin of the segment. The abdomen is continuously dorsally carinate from the third segment backwards. The carina of the third segment is but a low, glabrous elevation, but the dorsal carina becomes sharper gradually in the more posterior segments and terminates in a spinule in the sixth segment. The sixth segment carries also a spinule at each postero-ventral angle. The posterior margin of the fourth and fifth segments is slightly incised in the mid-dorsal line. Laterally the sixth abdominal segment is marked by three horizontal wavy lines, the middle line being formed by four more or less well defined cicatrices co-joined. The fifth segment has a similar line formed from three cicatrices.

The telson is somewhat longer than the sixth abdominal segment but it is surpassed by both the inner and outer uropods. Although it bears no spines, a row of short, stout setae is set along each dorso-lateral margin, the row being discrete posteriorly but less so anteriorly. The telson bears a dorso-median sulcus.

The eyes are rather small, being about $1/5$ the length of the carapace measured in the longer diameter of the cornea. The prosartema slightly surpasses the cornea: the stylocerite extends about mid-way along the cornea. The first segment of the antennular peduncle bears distally an elevation on the dorso-median margin and a spine at the outer angle. The second segment is about $2\frac{1}{2}$ times the length of the distal segment. The antennular flagella are about $2/3$ the length of their peduncle, being somewhat less than half the length of the carapace. The basicerite bears a small, blunt tooth on the outer distal margin. The lamina of the scaphocerite slightly exceeds the tip of the antennular peduncle although the lateral spine of the scale may or may not surpass the tip. Measured at its widest, the antennal scale is about $2\frac{1}{2}$ times as long as wide.

The third maxilliped attains the distal end of the carapocerite: the first leg attains the same level as the third maxilliped; the second leg surpasses the carapocerite by a finger: the third leg surpasses the carapocerite by the entire chela and a small portion of the carpus: the fourth leg attains the same level as the third maxilliped and the first leg, or falls slightly short of that level: the fifth leg, the distal three joints of which are very slender, attains the tip of the scaphocerite. The first three legs each bear a stout basal spine: there are no ischial spines. The fourth leg of the adult female carries a large coxal plate, while the posterior margin of the merus of the fifth leg of the adult male bears a notch and a single large blunt tooth.

The thelycum (Fig. 15) is quite characteristic in shape and bears but little resemblance to *Metapenaeus affinis* (H. Milne Edwards). The anterior plate is elevated considerably from the sternum and bears a clearly defined median groove. The width of the plate increases rapidly in the posterior half, and decreases even more rapidly after the maximum width has been attained. The plate at this reduction in width is directed towards the sternum, and is not seen readily in ventral view. The posterior lateral plates are inclined sharply to the sternum, being elevated anteriorly. Each lateral plate is partly covered in ventral view by an anterior projection from a transverse bar which lies posterior to the lateral plates. The disto-lateral horns of the petasma are exceeded anteriorly by the disto-median horns. (Fig. 16).

The present species is very similar to *Metapenaeus monoceros* (Fabr.), but it is difficult to see how it can be confused with *M. affinis* (H. Milne Edwards) as the body is not glabrous, the rostrum is slightly sigmoid, the anterior hepatic groove is curved, and the thelycum and the petasma differ widely in form. Apart from the features of the thelycum and petasma, the present species may be distinguished from *M. monoceros* by the ill defined post-rostral carina, by the lack of a carina on the first abdominal segment (although in this feature care has to be taken when specimens intermediate between the setose and the glabrous forms of *M. monoceros* are encountered) and by the slightly sigmoid rostrum.

In Singapore, *Metapenaeus necopinans* is taken irregularly from the prawn pond at Jurong, and forms part of the sung-dong net catches taken at Siglap.

The specimens on which the above description is based, a male and a female of 2.0 cm. and 2.3 cm. carapace length respectively, are recorded as the syntypes.

***Metapenaeus singaporensis* sp. nov. (Plate 12, Figs. 17, 18 & 19)**

The carapace is finely pilose antero-dorsally but is quite naked postero-ventrally. It bears epigastric, supra-orbital, antennal and hepatic spines: the antennal spine is stout, the hepatic and epigastric spines are sub-equal in size, while the supra-orbital spine is smaller and rather blunt. A well defined post-ocular groove is set below or a

little behind the base of the rostral tooth placed immediately anterior to the epigastric spine. The carapace bears also well defined cervical and anterior hepatic grooves, and clear, though less well defined orbito-antennal, branchio-cardiac and posterior hepatic grooves. The cervical groove extends about halfway from the hepatic spine to the mid-dorsal line. Immediately anterior to the hepatic spine a deep pit is formed at the confluence of the antennal and cervical grooves. From this pit the antero-ventral portion of the cervical groove runs straight postero-ventrally joining in a sharp angle the anterior hepatic groove which runs straight antero-ventrally until it curves gently horizontal or slightly antero-dorsally. A sharp hepatic carina demarks this anterior portion of the hepatic groove ventrally; an equally sharp anterior cervical carina, a well defined antennal carina and a blunt branchio-cardiac and posterior cervical carinae are also present.

The rostrum is straight or slightly upturned in the distal half, horizontal or slightly inclined upwards. It bears about 9 teeth distributed evenly along the dorsal margin, one of the teeth in addition to the epigastric being borne on the carapace. The post-rostral carina is well defined to within about $1/20$ of the posterior margin of the carapace.

The first, second and third abdominal segments are dorsally rounded and quite glabrous. The abdomen bears a dorsal carina starting at about $1/3$ to $1/2$ of the way along the mid-line of the fourth segment, and terminating in the sixth segment in a spinule. The posterior margin of the fourth and fifth segments is deeply incised in the mid-line. The fourth, fifth and sixth segments bear setose depressed areas, the areas becoming more pronounced posteriorly. The sixth segment bears laterally four cicatrices which are almost continuous in the form of a wavy line; the fifth bears three cicatrices, the foremost of which has at its anterior end the articulation between the fifth and fourth segments. Each postero-ventral angle of the sixth segment bears a small spine: the ratio of the length to depth of this segment is about 1.6. The telson is equal in length to the sixth abdominal segment and is well surpassed by the distal ends of the uropods. The dorso-lateral margin is unarmed although posteriorly there is some regularity in the arrangement of the dorso-lateral setae. The dorso-median line is marked by a clearly defined groove.

Borne dorsally by the basal segment of the eye-stalk is a small but clearly defined spine, directed anteriorly, upwards and inwards. The prosartema attains about the distal margin of the eye: the apex of the stylocerite falls short of the mid-line of the cornea. The basal segment of the antennular peduncle bears at its disto-lateral angle a spine: the intermediate segment of the peduncle is slightly over twice the length of the distal segment. The antennular flagella are shorter than their peduncle, being somewhat less than half the length of the carapace.

The basicerite may or may not carry a spine on the disto-lateral margin. The disto-lateral spine borne by the scaphocerite attains the distal end of the antennular peduncle; it is somewhat surpassed by the lamina of the scale. Measured at its widest part, the scale is about three times as long as wide. The third maxilliped attains or slightly surpasses the distal margin of the carpocerite. The first three pereopods bear each a basal spine, while the first bears in addition a most minute ischial spine. The first leg attains, or surpasses the carpocerite by up to half the finger: the second leg surpasses the carpocerite by up to the entire chela: the third leg attains about the distal end of the scaphocerite, falling short of, or surpassing it by about half the finger: the fourth leg falls short of, or slightly surpasses the distal end of the carpocerite: the fifth leg attains about the distal end of the second segment of the antennular peduncle, falling slightly short of, or slightly surpassing this limit. In general, the thoracic appendages of the female seem

to be somewhat longer than those of the male. No exopodite is carried by the fifth pereopod. Coxal plates are carried by the fourth legs of the female, while the merus of the fifth leg of the male bears a notch and a single rather blunt spine.

The thelycum of this species resembles superficially that of *Metapenaeus monoceros* (Fabr.), but differs from it considerably in detail. The anterior median plate is considerably elevated from the sternum to which it is attached by a slender septum. Anteriorly the plate is broad, the width decreasing uniformly to a narrow waist set at about $\frac{1}{4}$ of the length of the plate from the anterior end, from which the plate again becomes somewhat broader. The posterior lateral plates are somewhat auricular in outline, broad and flat save for the edge, notably the postero-lateral edge, which is turned away from the sternum. Between each lateral plate and the anterior median plate is located a rather bulbous structure (Anterior lateral plates?).

In the petasma the disto-lateral horns are surpassed anteriorly by the rather small disto-median horns.

The species is very similar to *Metapenaeus monoceros* (Fabr.) and may be confused readily with the glabrous form of that species which occurs in Singapore. Apart from the differences in the thelycum and the petasma however it may be distinguished from *M. monoceros* (Fabr.) by the presence of the spine on the basal segment of the eye-stalk.

The present species may be distinguished from *M. intermedius* Kishinouye by the absence of spines on the telson, and by the absence of the characteristic setose areas on the carapace and the abdomen, while from *M. affinis* (H. Milne Edwards) it may be distinguished by the curved hepatic groove.

M. singaporensis occurs irregularly in the prawn pond at Jurong. It has not been taken from the open sea.

The specimens on which the above description was based, a male and a female of 2.0 cm. and 2.9 cm. carapace length respectively, are recorded as the syntypes.

Summary

Notes are made on the 18 species of penaeid prawn contained in the genera *Solenocera*, *Penaeus*, and *Metapenaeus* recorded recently from Malayan waters. Of these species, three are new to science, *Solenocera kubo*, *Penaeus jejunos*, and *Metapenaeus singaporensis*, while one species, described originally by Alcock (1906) as *Metapenaeus affinis* (H. Milne Edwards) is redescribed as the new species *Metapenaeus necopinans*.

Acknowledgment

I wish to acknowledge my indebtedness to my colleague Mr. J. H. Wickstead for his assistance, both on land and at sea, in the collection of the specimens.

APPENDIX

(The following note on the validity of the generic names of penaeid prawns was prepared for the 6th meeting of the Indo-Pacific Fisheries Council held in Tokyo during September and October 1955.)

The validity of the generic names of Penaeid prawns

Penaeus Fabricius 1798

In *Opinion* 104 (1928) the generic name *Penaeus* Weber 1795 (Class Crustacea, Order Decapoda) was placed on the Official List of Generic Names in Zoology. Hemming (*Bull. Zool. Nom.* Vol. 6. Pt. 10, 1952) pointed out that the entry of the generic name *Penaeus*, so spelt, made on the Official List was in itself an error, *Penaeus* being a cheironym of *Peneus* Weber 1795. The name *Peneus* was first used by Weber on page 94 of his *Nomencl. Ent. Syst. Fabr.* (1795). In that work Weber cited three specific names as the names of species regarded as belonging to the nominal genus *Peneus*, but in each case the specific name cited was a *nomen nudum*. It was proposed by Hemming (op. cit.) that the generic name *Peneus* is itself therefore a *nomen nudum* having been published (1) without any verbal indication, and (2) without any previously published nominal species referred to it, and in consequence is invalid.

Weber's *Nomencl. Ent. Syst. Fabr.* was but an advance announcement of the system of classification devised by Fabricius. When Fabricius published his *Supplementum Entomologiae Systematicae*, 1798, the generic name in question was spelt *Penaeus*. Fabricius provided his genus *Penaeus* with a verbal diagnosis, and in addition referred validly described nominal species to that genus. At that time, *Penaeus* was an available generic name, and is therefore the valid name of the genus. Hemming (op. cit.) recommended that the International Commission on Zoological Nomenclature should delete from the Official List of Generic Names in Zoology the invalid name *Penaeus* (emend. of *Peneus*) Weber, 1795, and insert the name *Penaeus* Fabricius, 1798. This recommendation was accepted, and embodied in *Direction* 16.

Sicyonia H. Milne Edwards 1830

Up to 1914 the generic name *Sicyonia* Milne Edwards was used regularly for the well known genus of Penaeid prawn. In 1914, as is well known, Stebbing (*Ann. S. Afr. Mus.* Vol. 15) pointed out that the generic name *Sicyonia* was preoccupied, having been applied to a genus of Lepidoptera by Hübner in 1816 (*Verz. bekannt. Schmett.* (1)) and he proposed for Milne Edwards's genus the new name of *Eusicyonia*. However, Holthuis, 1952, (*Bull. Zool. Nom.* Vol. 6. Pt. 11. pp. 339-341.) noted that the earliest synonym of *Sicyonia* Milne Edwards is *Ruvulus* De Natale 1850 (*Descriz. zool. Plojaria Crost. Messina.* p. 20). The generic name *Ruvulus* was first used by Cocco in 1832 (*Effem. Sci. Lett. Sicilia.* Vol. 2, p. 204) but it was published as a *nomen nudum*. De Natale (loc. cit.) made clear the synonymy of *Ruvulus* and *Sicyonia* Milne Edwards by placing the former name in parentheses behind the latter, and in consequence, were the Règles to be adhered to strictly, *Ruvulus* De Natale 1850 would be correct name for the genus in question.

Holthuis (loc. cit.) pointed out that the name *Ruvulus* is practically unknown: that the name *Eusicyonia* is invalid, precedence being taken by *Ruvulus*: that the name *Sicyonia* Hübner 1816 is no longer used for the genus of Lepidoptera to which it was applied: that the name *Sicyonia* Milne Edwards 1830 was adopted universally from 1830 till 1914, and that even after 1914 many carcinologists continued to use it. He proposed therefore that the International Commission on Zoological Nomenclature should use its plenary powers to suppress the generic names *Sicyonia* Hübner 1816, and *Ruvulus* De Natale 1850, and validate the generic name *Sicyonia* Milne Edwards 1830. This proposal was accepted, and embodied in *Opinion* 382.

Parapeneopsis (Wood Mason, M. S.) Alcock 1901, and

Xiphopeneus Smith 1886

The valid spelling of the above cited compound generic names, as of all other generic names of Penaeid prawn, is that published by the first authors. There has as yet (16th August, 1955) been no proposal to the International Commission on Zoological Nomenclature recommending the use of the plenary powers of the Commission to adjust the spelling of *Parapeneopsis* and *Xiphopeneus* to conform to the more barbaric spelling of the root name *Penaeus* Fabr. 1798, although Mr. Francis Hemming, the Secretary to the Commission on Zoological Nomenclature, with whom I have been in recent communication, is sounding carcinologists on this subject. It is suggested that those who are interested should forward their opinion direct to Mr. Hemming whose full address is:

F. Hemming Esq., C.M.G., C.B.E.,

Secretary to the International Commission on Zoological
Nomenclature,

28, Park Village East,

Regent's Park,

London, N.W.1.

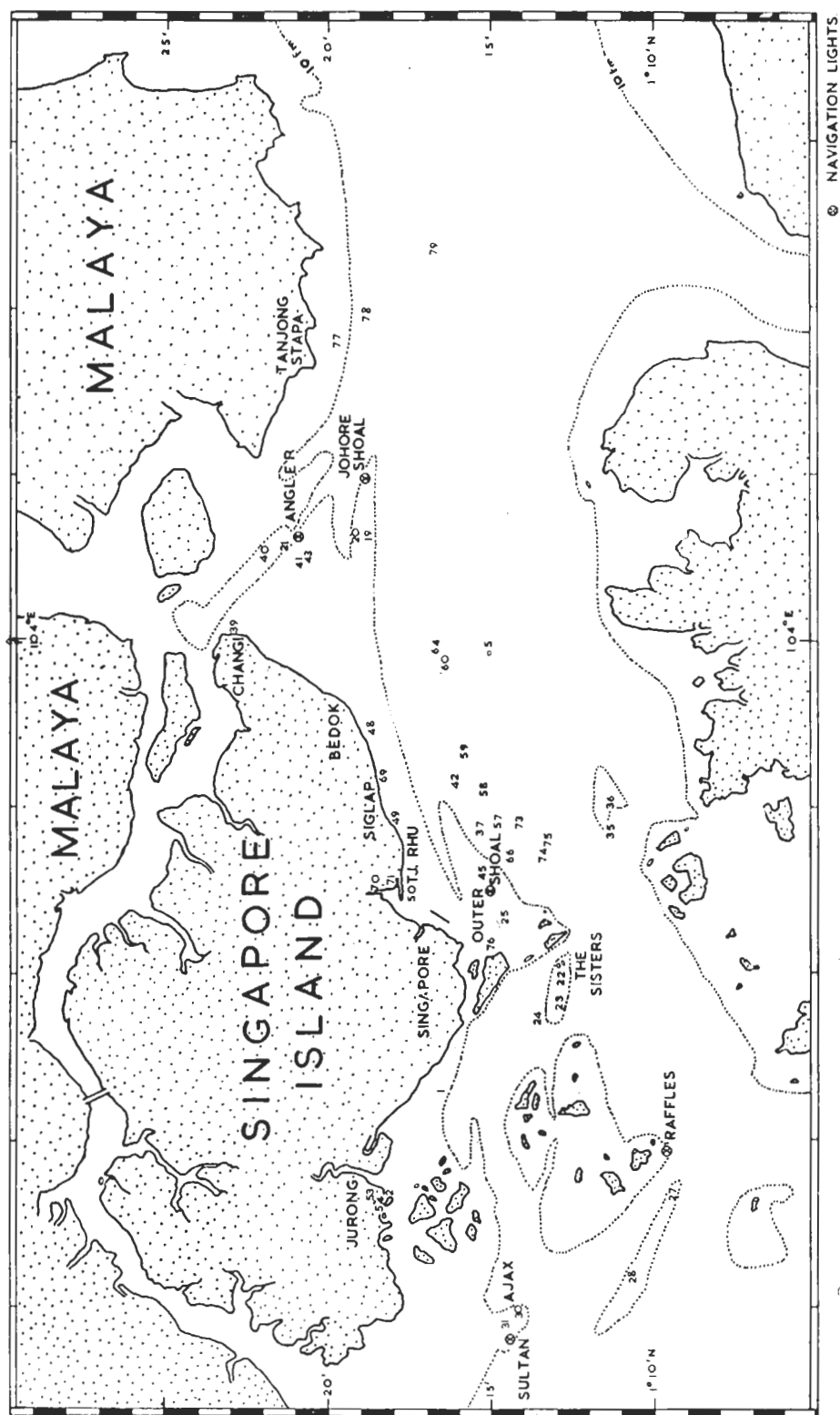
(Signed) DENNIS N. F. HALL,
Singapore Regional
Fisheries Research
Station.

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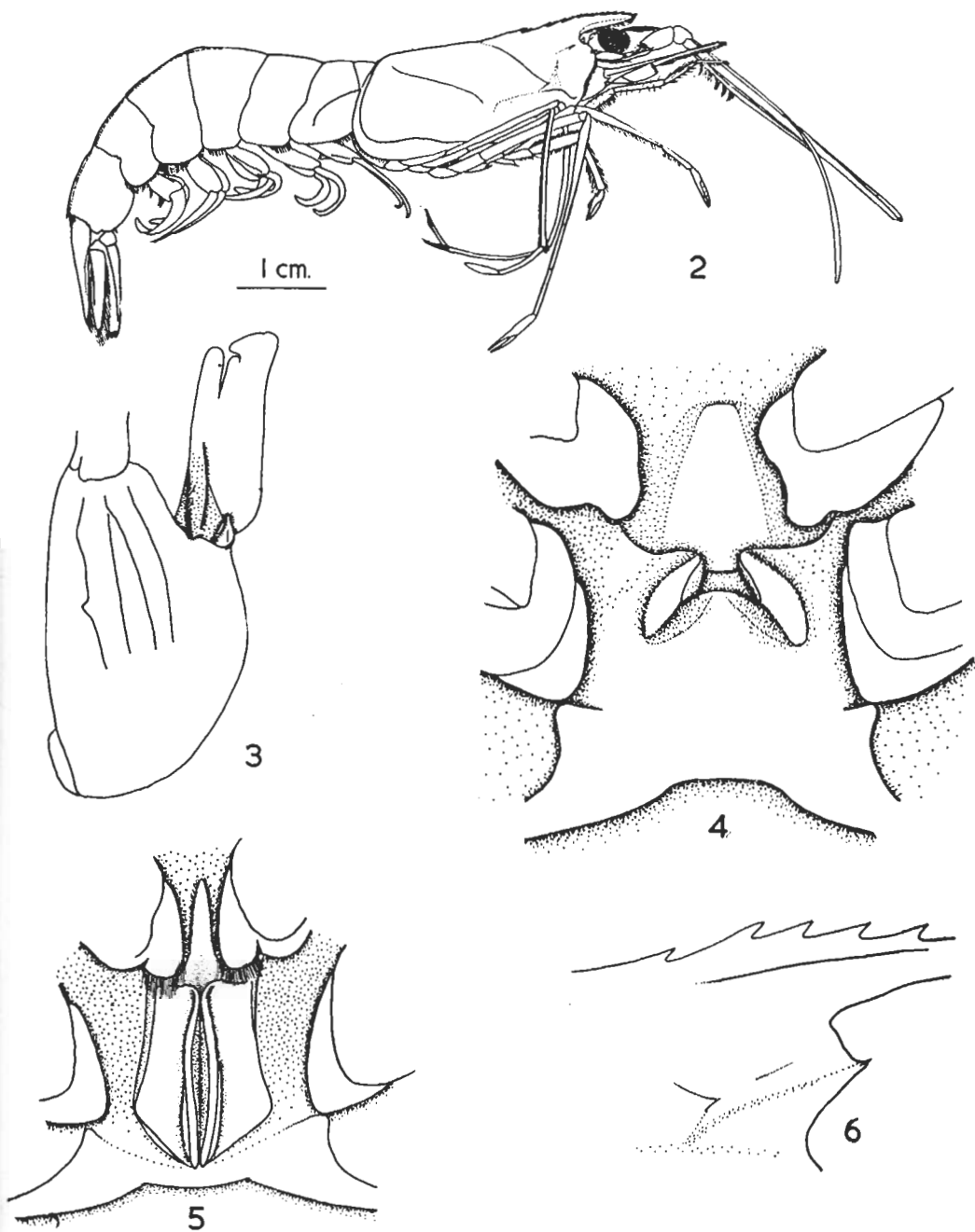
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Explanation of Plates

- Plate 8, Fig. 1. A chart of the local Singapore waters.
- Plate 9, Fig. 2. *Solenocera kubo* sp. nov. Male (2.2 cm. carapace).
3. *Solenocera kubo* sp. nov. Petasmal endopodite of the right hand side: ventral view.
4. *Penaeus japonicus* Bate. Thelycum (2.6 cm. carapace).
5. *Penaeus longistylus* Kubo. Thelycum (4.3 cm. carapace).
6. *Penaeus penicillatus* Alcock. Anterior portion of the carapace. Adult male (2.2 cm. carapace).
- Plate 10, Fig. 7. *Penaeus merguiensis* De Man. Anterior portion of the carapace. Adult female (3.4 cm. carapace).
8. *Penaeus indicus* H. Milne Edwards. Anterior portion of the carapace. Immature female (2.1 cm. carapace).
9. *Penaeus jejunos* sp. nov. Female (1.5 cm. carapace).
10. *Penaeus jejunos* sp. nov. Thelycum.
11. *Metapenaeus monoceros* (Fabr.). Tip of petasma: ventral view (2.3 cm. carapace).
- Plate 11, Fig. 12. (a) *Metapenaeus brevicornis* (H. Milne Edwards). Tip of the telson: dorsal view. Adult male (2.0 cm. carapace).
- (b) *Metapenaeus monoceros* (Fabr.) Lateral margin of the telson: dorsal view. Adult male (2.3 cm. carapace).
13. *Metapenaeus intermedius* Kishinouye. Tip of petasma: ventral view (2.7 cm. carapace).
14. *Metapenaeus affinis* (H. Milne Edwards). Thelycum (2.2 cm. carapace).
15. *Metapenaeus necopinans* sp. nov. Thelycum (2.3 cm. carapace).
- Plate 12, Fig. 16. *Metapenaeus necopinans* sp. nov. Petasma (2.0 cm. carapace).
17. *Metapenaeus singaporensis* sp. nov. Female (2.9 cm. carapace).
18. *Metapenaeus singaporensis* sp. nov. Thelycum (2.9 cm. carapace).
19. *Metapenaeus singaporensis* sp. nov. Petasma (2.0 cm. carapace).



A chart of the local Singapore waters. (D. N. F. Hall).



Figs. 2, 3, *Solenocera kuboii*; 4, *Penaes japonicus*; 5, *P. longistylus*; 6, *P. penicillatus*. (D. N. F. Hall).

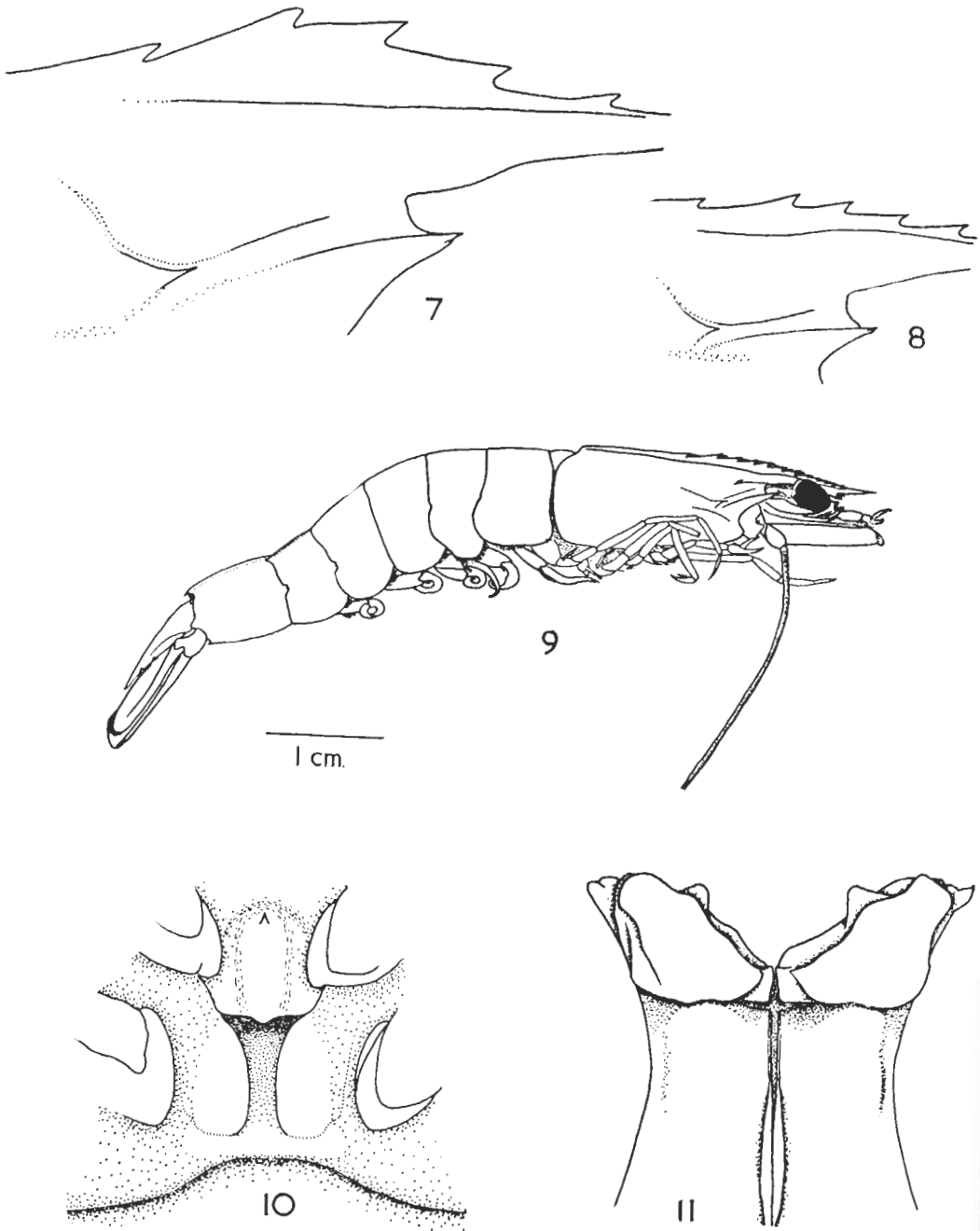


Fig. 7, *Penaeus merguiensis*; 8, *P. indicus*; 9, 10, *P. jejunus*; 11, *Metapenaeus monoceros*. (D. N. F. Hall).

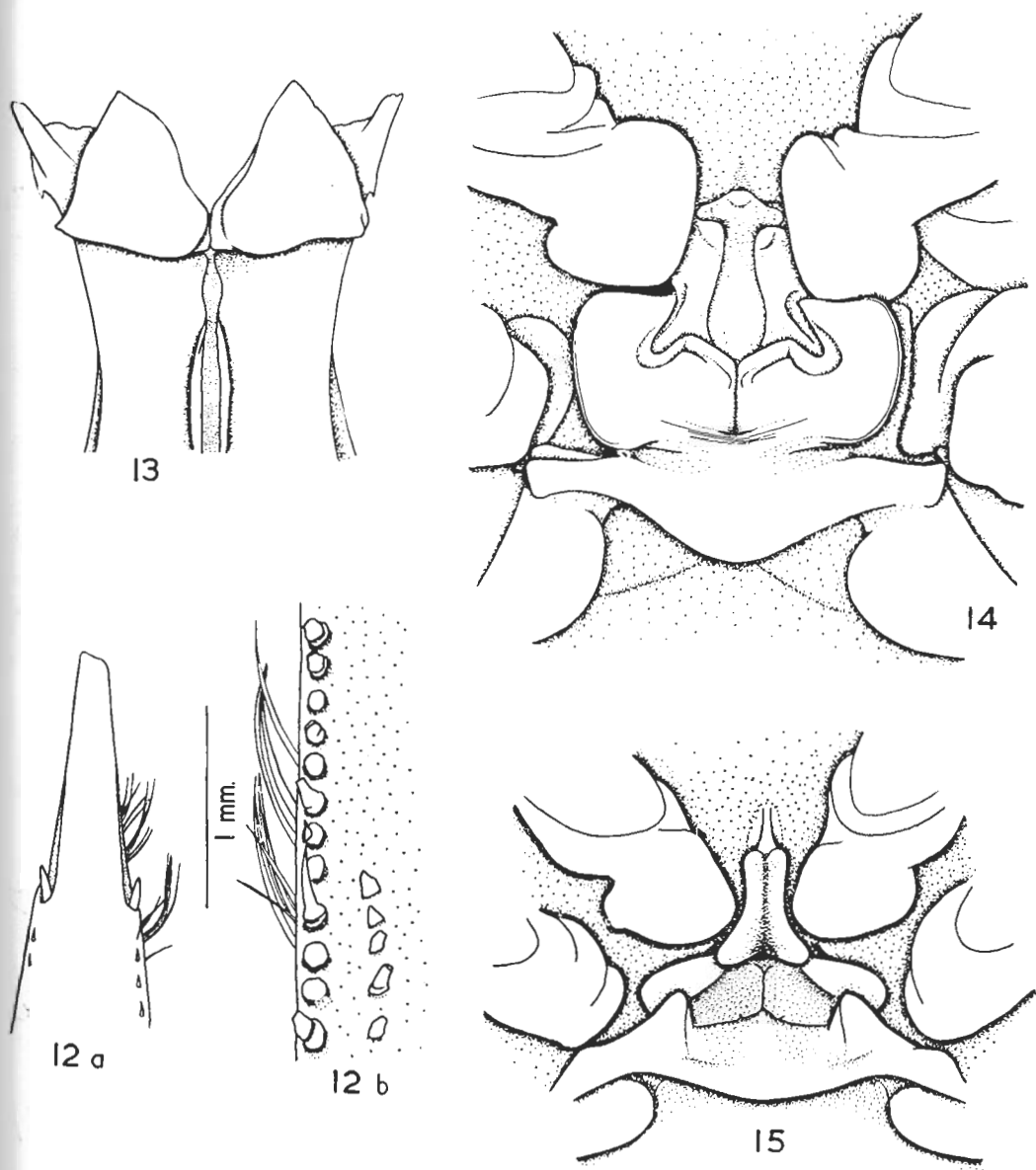


Fig. 12a, *Metapenaeus brevicornis*; 12b, *M. monoceros*; 13, *M. intermedius*; 14, *M. affinis*; 15, *M. necopinans*. (D. N. F. Hall).

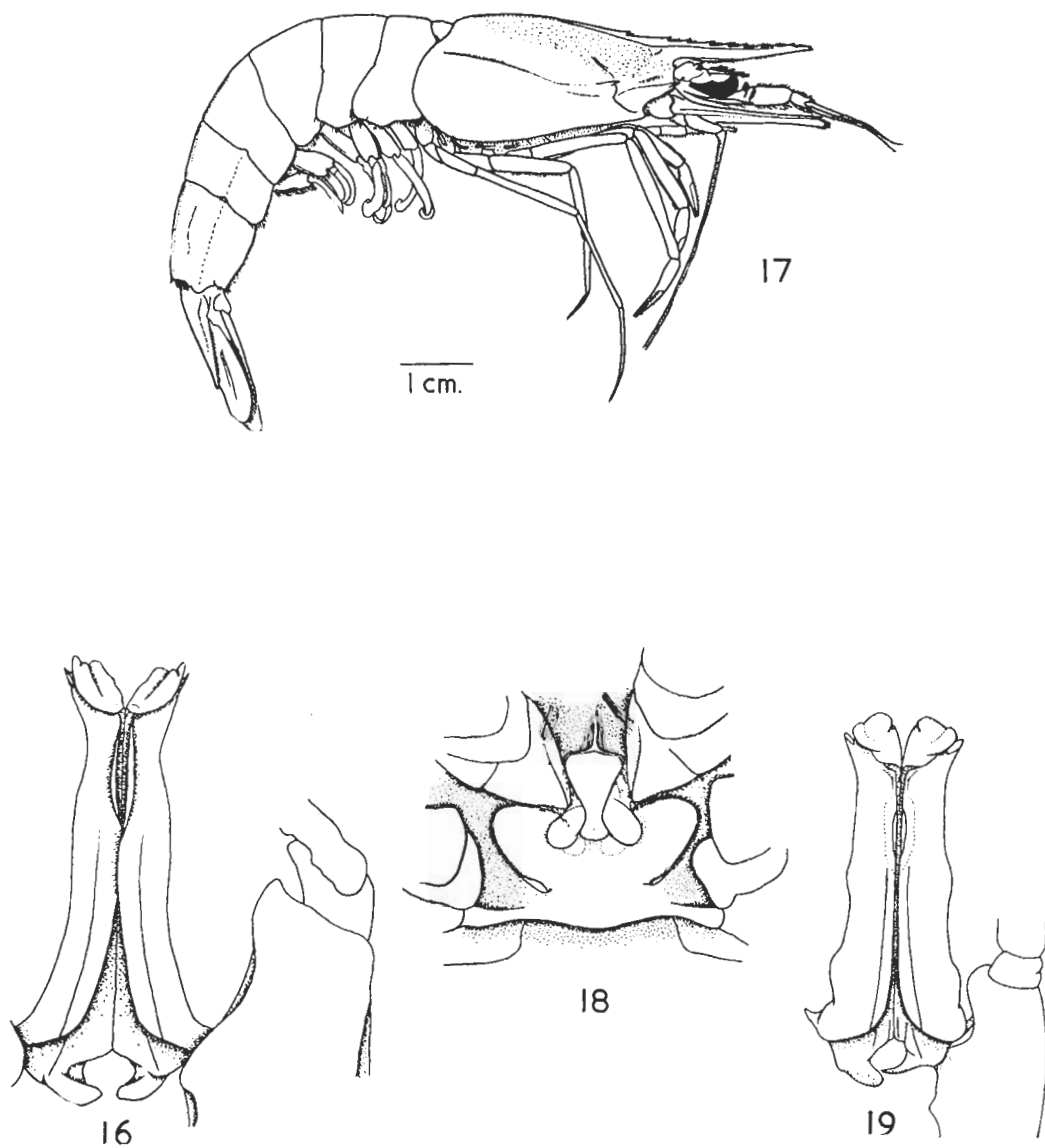


Fig. 16. *Metapenaeus necopinans*, 17-19, *M. singaporensis*. (D. N. F. Hall).